Instability and impedance studies

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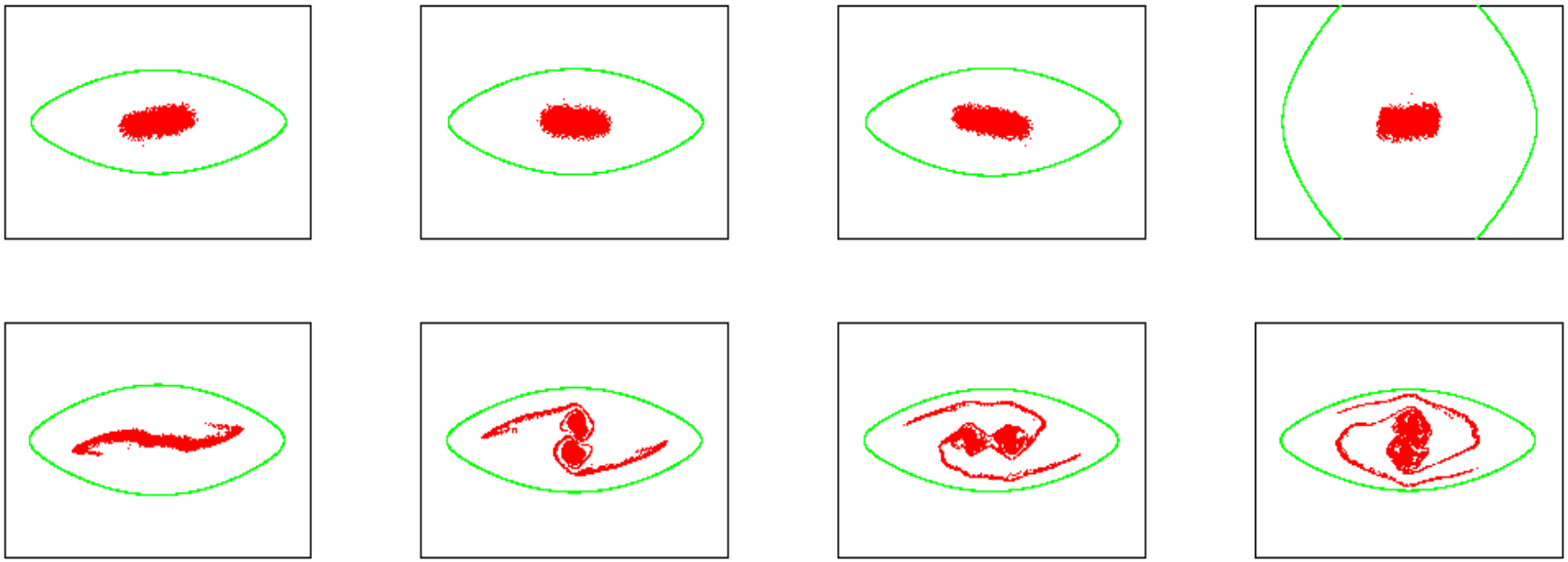
Transition studies

Take WCM, γt quads, RF voltage and phase. Can tomography give us an effective Z/n?

With a single bunch and quadrupole mode damping on 28 MHz can emittance growth be reduced enough to warrant a bunch by bunch system?



Behavior of a single proton bunch after 40 min

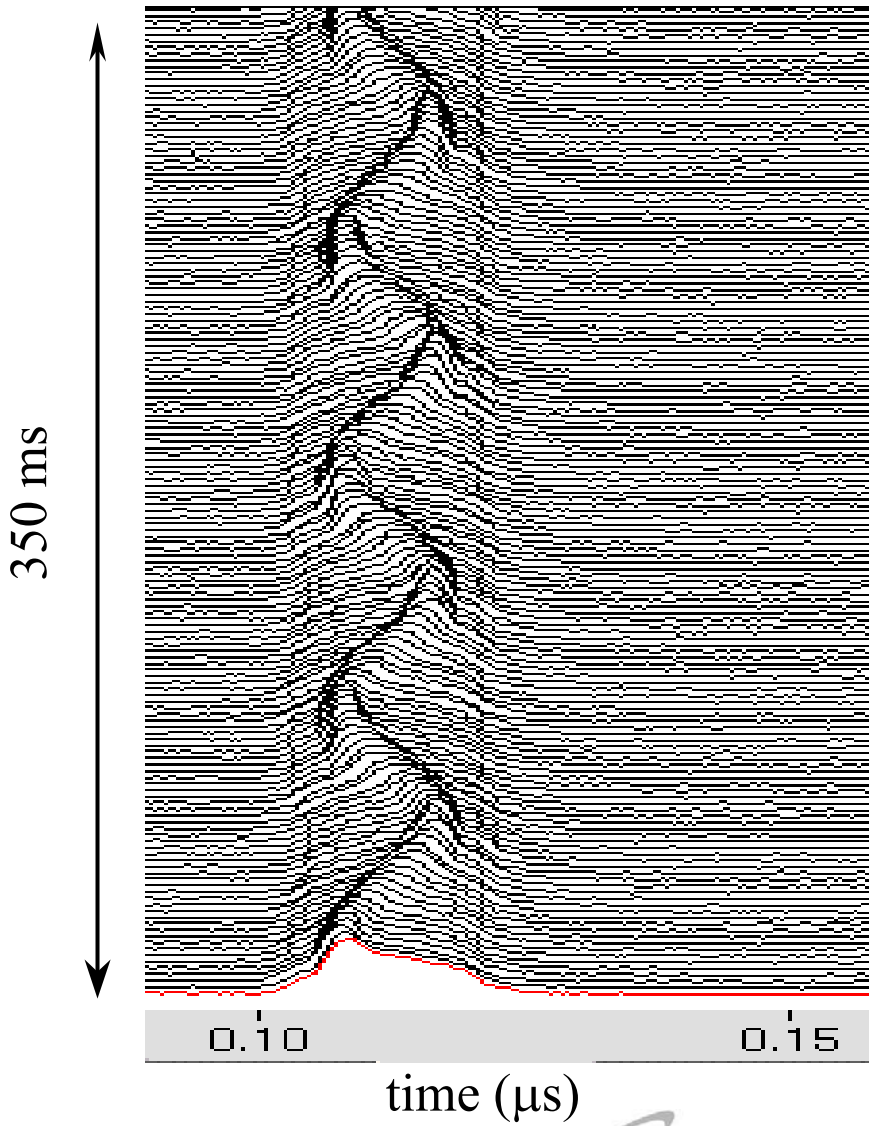
Single particle dynamics gives

$$\delta\omega_s = \omega_s(0)(\varphi_+^2 - \varphi_-^2)/16$$

This is of order 10/s so there are collective effects.

Measure beam response functions for dipole and quadrupole modes giving broadband Z/n

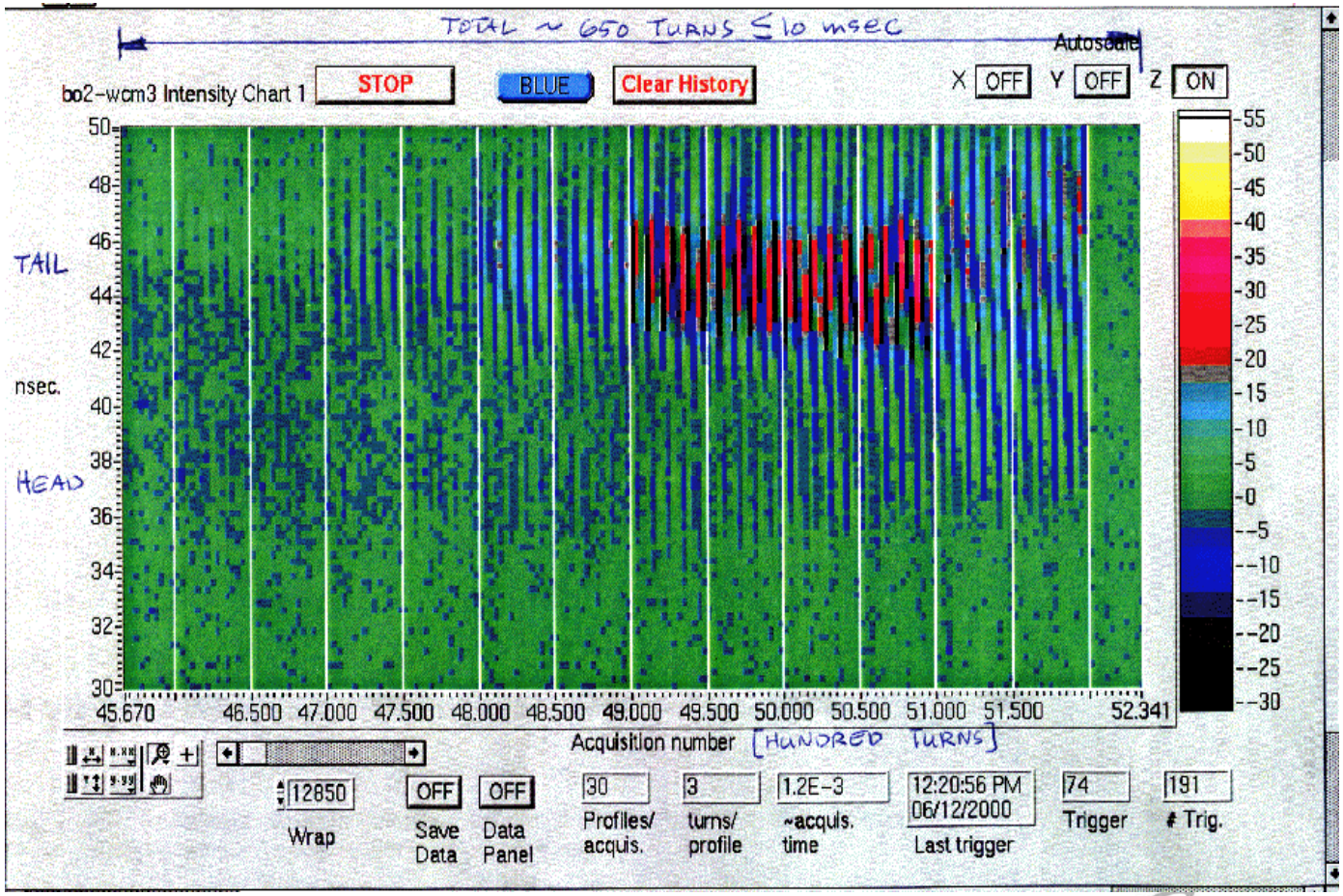
Expected synchrotron frequency shifts are greater than the single particle frequency spread ≈ Hz



Fast transverse instability near transition

Half beam lost in O(10 ms), near chromaticity=0, octupoles stabilize

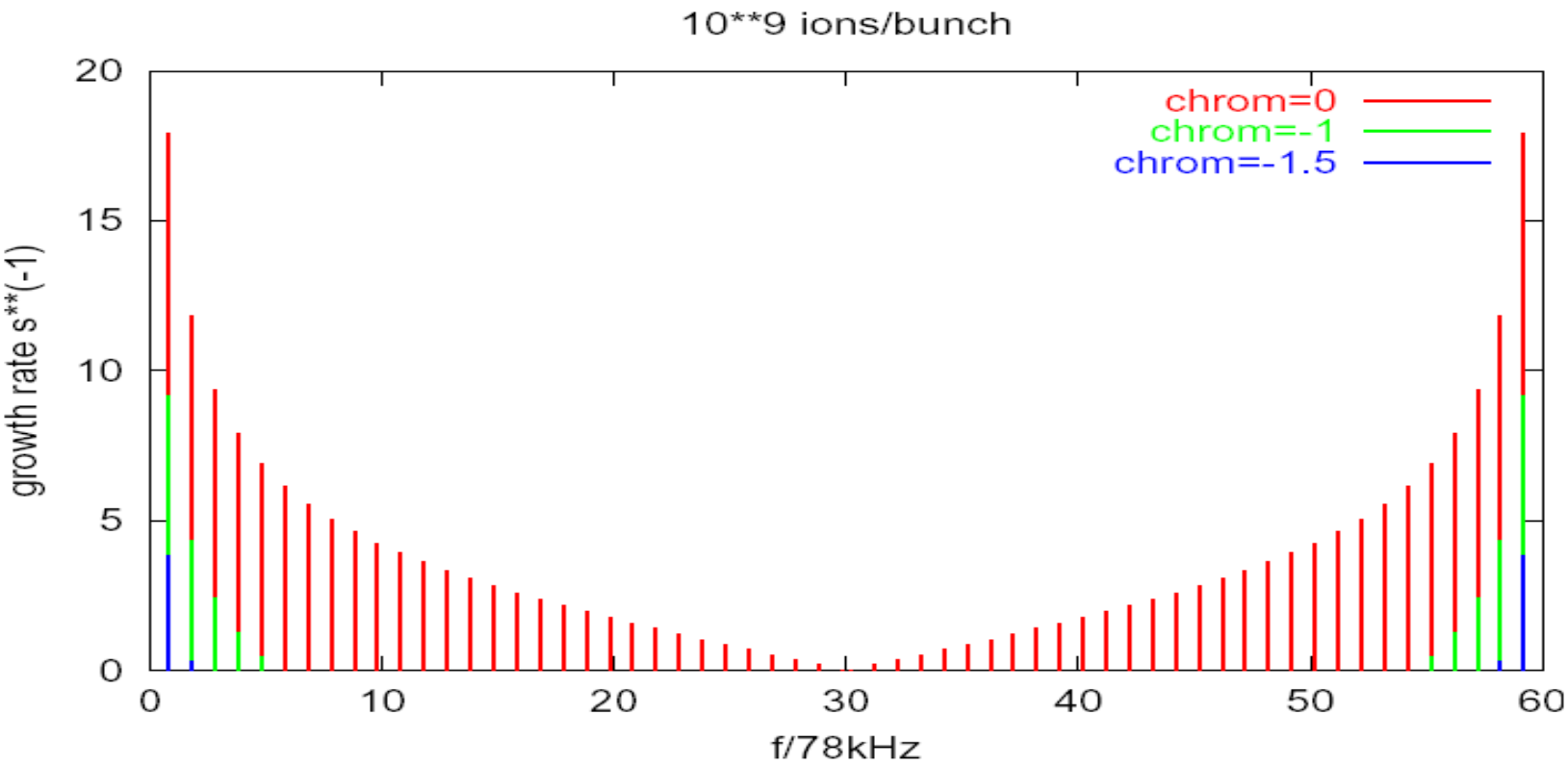
Mountain range triggered at transition then, perhaps, using betatron power



Transverse coupled bunch

Standard formulas give growth rates for various coupled bunch modes

Observations of growth rates for the modes will test the narrow band impedance model



Summary

Both longitudinal and transverse instabilities are major considerations for high intensity operations.

Better estimates of both the transverse and longitudinal wake potentials will improve understanding and strategies.

Quadrupole damper for longitudinal at transition?

Acquiring better data for the fast loss after transition is a priority. This is largely a triggering/data storage issue.